

Greetings and welcome to the **NOVEMBER, 2013** edition of the WDFW Climate News Digest. The purpose of this digest is to provide highlights of relevant climate change news, events and resources for WDFW staff. Feedback or suggestions for items to include in future editions are much appreciated – many *thanks* to those who have sent links and references and please keep them coming. Previous editions of the newsletter are now stored on the Habitat Program Sharepoint site -- <http://sharepoint.dis.wa.gov/dfw/habitat/climatechange/default.aspx>. **Note a new feature launches with this month's edition, a climate change mini quiz – check it out!**

Thanks for contributions this month from Stephen Kalinowski, Marc Hayes, Jason Wettstein, Amy Windrope and David Patte (USFWS).

WHAT'S HAPPENING AT WDFW?

[Safeguarding Washington's Fish and Wildlife in an Era of Climate Change: A Case Study of Partnerships in Action \(2013\)](#)

The National Wildlife Federation recently published a report documenting a collaborative project with WDFW to develop tools and resources to help the agency address climate change. The multi-faceted effort included both science and policy elements. On the science side, we worked with the University of Washington to conduct a series of workshops to assess the relative sensitive sensitivity of different habitat types to climatic changes, the results of which are now part of [a climate sensitivity database](#) housed at the UW. Other science products included the production of four “[climate science summaries](#)”, which compiled existing literature on climate change impacts to habitats in Washington and are now available on the WDFW website. Policy elements included developing material and draft recommendations for the Ecosystems chapter of the [Washington State Climate Change Response Strategy](#), completed in 2012. For more, see the report or be in touch with Lynn. A link to the report is provided above –we also have a good supply of hard copies. Let Lynn know if you'd like one and I'd be happy to send it your way.

***New Feature* NOVEMBER CLIMATE QUIZ QUESTIONS (answers at bottom)**

1. According to global surface temperature data from the National Oceanic and Atmospheric Administration and NASA's Goddard Institute for Space Studies, how many of the top 10 hottest years on record have occurred in the past 10 years?
2. How many pounds of carbon dioxide is released by burning one gallon of gasoline?
 - a. About 1 lb.
 - b. About 5 lbs.
 - c. About 10 lbs.
 - d. About 20 lbs.
3. About how many tons of carbon dioxide does the average American emit annually?
 - a. Two
 - b. Ten
 - c. Twenty
 - d. One hundred

CLIMATE ADAPTATION AT OTHER ORGANIZATIONS

Executive Order on Preparing the U.S. for the Impacts of Climate Change

The [Executive Order](#) issued by the President on November 1 includes the following actions:

- Modernizing Federal programs to support climate resilient investment;
- Federal inventory and assessment of proposed and completed changes to agency land- and water-related policies, programs, and regulations necessary to make the Nation's watersheds, natural resources, and ecosystems, and the communities and economies that depend on them, more resilient in the face of a changing climate;
- Federal program and policy adjustments that promote the dual goals of greater climate resilience and carbon sequestration,
- Development and dissemination of authoritative, easily accessible, usable, and timely data, information, and decision-support tools on climate preparedness and resilience;
- Establishment of a web-based portal on "Data.gov" for data and tools relevant to climate issues and decision making;
- Development or continued development, implementation, updating and reporting of comprehensive federal agency plans (Agency Adaptation Plans) that integrate consideration of climate change into agency operations and overall mission objectives;
- Establishment of a federal Council on Climate Preparedness and Resilience;
- Establishment of a State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience

British Columbia, California, Oregon and Washington Join Forces to Combat Climate Change

On October 28th, West Coast leaders announced a commitment to account for the costs of carbon, and promote clean fuel standards and other clean energy priorities for the region of 53 million people. In a joint action plan, the leaders committed to “meaningful coordination and linkage between states and provinces across North America.” [Read more...](#)

LEARNING OPPORTUNITIES

Wednesday, November 6, 2013, 12:30 pm Pacific time, “Recognizing Resilience:

Understanding community-based responses to acute and chronic disturbance”, Erika Svendsen, US Forest Service, Northeast Climate Science Center webinar.

To join or register [click here](#).

Wednesday, November 13, 2013 10:00-11:30, Pacific Time, “Use of Natural and Nature-Based Features to Enhance the Resilience of Coastal Systems”, presenters include: Todd Bridges and Paul Wagner, U.S. Army Corps of Engineers

This webinar provides an overview of a project to identify and evaluate opportunities to use natural and nature-based features (NNBF) to support coastal resilience and risk reduction in the context of planning, construction, and operations and maintenance activities. NNBF include beach-dune complexes, barrier islands, wetlands, tidal flats and many other features that can provide both engineering and environmental functions in the context of coastal storms and resilience. The webinar will provide an overview of the framework, its technical components, and future plans regarding the effort.

Additional information can be found on the Study website

at: <http://www.nad.usace.army.mil/Missions/CivilWorks/HurricaneSandyCoastalRecovery/NorthAtlanticComprehensiveStudy.aspx>

YOU MUST REGISTER TO JOIN THIS WEBINAR

<https://fedgov.webex.com/fedgov/k2/j.php?ED=217711632&UID=1344971617&HMAC=05a9623597759f0d3142d785eb72e5aeee8658d9&RT=MiMxMQ%3D%3D&FM=1>

Thursday, November 14, 10:00 am Pacific Time, “Impacts of Sea Level Rise on National Parks”, presented by Rebecca Beavers and Courtney Schupp of the US National Park Service. Climate change and sea level rise will challenge National Park efforts to protect natural and cultural resources and to provide visitor access and recreational opportunities. Learn how several national parks are addressing these challenges: collecting baseline data on archaeological sites that are vulnerable to rising water levels and associated changes in biological activity and visitor use; incorporating barrier island processes into long-term development plans including visitor facilities; and engaging in a regional multi-agency effort to restore coastal areas impacted by a major hurricane. Webinar co-hosted by the NOAA National MPA Center, MPA News, and OpenChannels. **Register for the webinar at <https://www1.gotomeeting.com/register/846023408>.**

Thursday, December 12, 10:00 am Pacific Time, Webinar on “Assessing Habitat and Community Sensitivity to Climate Change Impacts”, by Jeff Crooks of the Tijuana River National Estuarine Research Reserve and Dwight Trueblood of NOAA. The National Estuarine Research Reserves (NERRS) are uniquely positioned across the U.S. to assess climate change impacts and the sensitivity of representative coastal habitats to them. The NERRS Climate Sensitivity Study identified key anthropogenic and climatic stressors affecting each reserve’s ecological and social landscape and then analyzed the social and bio-physical sensitivity to these stressors. Presenters will share key findings from this study, and the Tijuana River Reserve in California will discuss their collaborative efforts to develop a vulnerability assessment that informs an Adaptation Strategy to address sea level rise and riverine flooding. Webinar co-hosted by the NOAA National MPA Center, MPA News, and OpenChannels. **Register for the webinar at <https://www1.gotomeeting.com/register/858423992>.**

Wednesday, January 22, 10:00 am Pacific Time, Webinar on “Valuing Ecosystem Services in the Face of Climate Change in North Carolina and Hawaii”, by Ken Bagstad of USGS. To correctly value ecosystem services both today and when considering future climate change and adaptation strategies, we must properly account for service supply by ecosystems, demand by people, and service flows from ecosystems to people. This webinar will present two case studies of the use of two spatially explicit approaches to providing this information: a biophysical modeling tool, the Artificial Intelligence for Ecosystem Services (ARIES) system and a survey-based approach to map cultural ecosystem services, Social Values for Ecosystem Services (SolVES). These modeling and valuation tools are being used in partnership with several Federal agencies to answer questions about climate change and adaptation in coastal North Carolina and for coral reefs in Maui. Learn more about ARIES at www.ariesonline.org and SolVES at <http://solves.cr.usgs.gov>. Webinar co-hosted by OpenChannels.org. **Register for the webinar at <https://www1.gotomeeting.com/register/430384376>.**

RESOURCES

YOUR WARMING WORLD

The heat is on for the planet as a whole, but what has been happening where you live? Click on the map to find out, or enter a location in the search box at top right. The initial map shows average temperatures over the past 20 years; use the drop-down menu to see maps for earlier periods.

More: Read the [climate change topic guide](http://warmingworld.newscientistapps.com/) and learn about the data and graphic.
<http://warmingworld.newscientistapps.com/>

Tools for Climate Change Vulnerability Assessments for Watersheds

Released by the Canadian Council of Ministers of the Environment, this compendium of tools was prepared to aid technical experts, adaptation planners and resource managers in developing climate change vulnerability assessments of water quantity and water quality at a watershed scale. The report can be accessed here: http://www.ccme.ca/assets/pdf/pn_1494_vat.pdf

Green Infrastructure Strategic Agenda

The US EPA has released an updated [Green Infrastructure Strategic Agenda](#) and has created a greenstream listserv featuring updates on green infrastructure publications, training, and funding opportunities. If you're interested in joining, send an email to join-greenstream@lists.epa.gov.

Office of the Washington State Climatologist

The OWSC Newsletter contains information on the current state of Washington's climate, including the current outlook and a review of notable climate and weather events. The newsletter is produced monthly and will be available on our website or by e-mail subscription. To receive the newsletter by e-mail, visit the [Climate newsletter](#) subscription page. The [October](#) edition of the [OWSC newsletter](#) is available for download. Topics include: September climate summary, New IPCC report released, a summary of fog climatology for WA, temperature and precipitation outlook.

EPA's Climate Ready Estuaries Program Releases Draft Workbook on Developing Climate Change Adaptation Plans

EPA has released a draft workbook for environmental professionals and city managers to help identify and manage risks associated with climate change, and is seeking comments from the public on the draft. The document, "Being Prepared for Climate Change: A Workbook for Developing Risk-Based Adaptation Plans," provides a systematic process for environmental professionals and city managers to use in determining important climate risks that should be addressed, along with approaches for building local capacity to understand and manage these risks to protect future generations. To review the draft workbook, visit: <http://water.epa.gov/type/oceb/cre/news.cfm>.

Climate Change in the Northwest: Implications for Our Landscapes, Waters, and Communities

The foundation report for the Pacific Northwest chapter of the U.S. National Climate Assessment is now available in PDF format and for purchase from Island Press. The report assesses the current state of knowledge about key climate impacts and consequences to various sectors and communities in the Pacific Northwest, including projected impacts on hydrology and water supply, coasts and oceans, forest ecosystems, agriculture, human health, and northwest tribes. For more information or to download a copy of the report, go to: <http://cses.washington.edu/db/pdf/daltonetal678.pdf>

CLIMATE SCIENCE NEWS

Latest IPCC Climate Report Puts Geoengineering in the Spotlight

A statement by the U.N.-convened group suggests that tinkering with the atmosphere could be necessary to meet climate goals

From [Nature magazine](#) (published in Scientific American)

“Attempts to counter global warming by modifying Earth's atmosphere have been thrust into the spotlight following last week's report from the United Nations' Intergovernmental Panel on Climate Change (IPCC). Mention of 'geoengineering' in the report summary was brief, but it suggests that the controversial area is now firmly on the scientific agenda. Some climate models suggest that geoengineering may even be necessary to keep global temperature rises to below 2 °C above pre-industrial levels. Most geoengineering technologies generally either reflect sunlight — through artificial 'clouds' of stratospheric aerosols, for example — or reduce the amount of greenhouse gases in the atmosphere. The latter approach, described as 'negative emissions', involves capturing carbon dioxide with strategies that range from building towers to collect it from the atmosphere to grinding up rocks to react with CO₂ and take it out of circulation. Critics say that the technologies are unproven, will have unforeseen impacts and could distract from attempts to limit emissions of greenhouse gases. But advocates point to language in the summary for policy-makers produced by the IPCC working group that assessed the scientific evidence for climate change as evidence that reducing emissions will not be enough. The document notes that a “large fraction” of anthropogenic climate change is irreversible except with a “large net removal of CO₂ from the atmosphere over a sustained period”.

Global warming may affect intensity of droughts and floods driven by El-Nino-Southern Oscillation (ENSO)

Scientists say they are more certain than ever about the impact of global warming on a critical weather pattern. The El Nino-Southern Oscillation (ENSO) occurs in the Pacific Ocean but plays an important part in the world's climate system. Researchers have until now been unsure as to how rising temperatures would affect ENSO in the future. But a new study suggests that droughts and floods driven by ENSO will be more intense. The ENSO phenomenon plays a complicated role in the global weather system. The El Nino part of the equation sees a warming of the eastern and tropical Pacific, while its cooler sister, La Nina, makes things chillier in these same regions. Like water in a bathtub, the warmer or cooler waters slosh back and forth across the Pacific Ocean. They are responsible for rainfall patterns across Australia and the equatorial region, but their effects are also felt much further away. During the Northern Hemisphere winter, for example, you can get more intense rainfall over the southern part of the US in a warmer El Nino phase. For years, scientists have been concerned about how this sensitive weather system might be changed by rising temperatures from global warming.

<http://www.nature.com/nature/journal/vaop/ncurrent/full/nature12580.html>

Humble clumps of moss yield sobering climate surprises

It has been something of an article of faith among skeptics of humanity's role in global warming: The rise in temperatures observed in recent decades can't be definitively pinned on humans because nature has produced temperatures during the past 11,000 years that were just as warm. But now, research involving moss that died at least 40,000 years ago has debunked this argument.

Yosemite's largest ice mass is melting fast

(from LA TIMES) Climate change is taking a visible toll on Yosemite National Park, where the largest ice mass in the park is in a death spiral, geologists say. During an annual trek to the glacier deep in Yosemite's backcountry last month, Greg Stock, the park's first full-time geologist, found that Lyell Glacier had shrunk visibly since his visit last year, continuing a trend that began more than a century ago. Lyell has dropped 62% of its mass and lost 120 vertical feet of ice over the last 100 years. "We give it 20 years or so of existence — then it'll vanish, leaving behind rocky debris," Stock said. The Sierra Nevada Mountains have roughly 100 remaining glaciers, two of them in Yosemite. The shrinkage of glaciers across the Sierra is also occurring around the world. Great ice sheets are dwindling, prompting

concerns about what happens next to surrounding ecological systems after perennial rivulets of melted ice disappear

By 2047, Coldest Years May Be Warmer Than Hottest in Past (JUSTIN GILLIS, NY Times)

If greenhouse emissions continue their steady escalation, temperatures across most of the earth will rise to levels with no recorded precedent by the middle of this century. Scientists from the University of Hawaii at Manoa calculated that by 2047, plus or minus five years, the average temperatures in each year will be hotter across most parts of the planet than they had been at those locations in any year between 1860 and 2005. To put it another way, for a given geographic area, “the coldest year in the future will be warmer than the hottest year in the past,” said [Camilo Mora](#), the lead scientist on a [paper](#) published in the journal *Nature*.

Is Global Heating Hiding out in the Oceans? Parts of Pacific Warming 15 Times Faster Than in Past 10,000 Years

October 31, 2013 — In a reconstruction of Pacific Ocean temperatures in the last 10,000 years, researchers have found that its middle depths have warmed 15 times faster in the last 60 years than they did during ... A recent slowdown in global warming has led some skeptics to renew their claims that industrial carbon emissions are not causing a century-long rise in Earth's surface temperatures. But rather than letting humans off the hook, a new study in the leading journal *Science* adds support to the idea that the oceans are taking up some of the excess heat, at least for the moment. In a reconstruction of Pacific Ocean temperatures in the last 10,000 years, researchers have found that its middle depths have warmed 15 times faster in the last 60 years than they did during apparent natural warming cycles in the previous 10,000.> [full story](#)

SPECIES AND HABITATS

Biotic and Human Vulnerability to Projected Changes in Ocean Biogeochemistry over the 21st Century

Ongoing greenhouse gas emissions can modify climate processes and induce shifts in ocean temperature, pH, oxygen concentration, and productivity, which in turn could alter biological and social systems. Here, researchers provide a synoptic global assessment of the simultaneous changes in future ocean biogeochemical variables over marine biota and their broader implications for people. They analyzed modern Earth System Models forced by greenhouse gas concentration pathways until 2100 and showed that the entire world's ocean surface will be simultaneously impacted by varying intensities of ocean warming, acidification, oxygen depletion, or shortfalls in productivity. If co-occurring biogeochemical changes influence the delivery of ocean goods and services, then they could also have a considerable effect on human welfare. Approximately 470 to 870 million of the poorest people in the world rely heavily on the ocean for food, jobs, and revenues and live in countries that will be most affected by simultaneous changes in ocean biogeochemistry. These results highlight the high risk of degradation of marine ecosystems and associated human hardship expected in a future following current trends in anthropogenic greenhouse gas emissions. (Mora C, Wei C-L, Rollo A, Amaro T, Baco AR, et al. (2013) *Biotic and Human Vulnerability to Projected Changes in Ocean Biogeochemistry over the 21st Century*. *PLoS Biol* 11(10): e1001682. doi:10.1371/journal.pbio.1001682)

Temperature-dependent shifts in phenology contribute to the success of exotic species with climate change

There is increasing evidence that exotic species occupy unique phenological niches and track climate change more closely than native species. This research provides cross-site support for the role of phenology and climate change in explaining species' invasions. Further, it supports recent evidence that exotic species may be important drivers of extended growing seasons observed with climate change in North America.

(Wolkovich et al., 2013, *American Journal of Botany* 100(7): 1407-1421)

Potential for evolutionary responses to climate change – evidence from tree populations

Using data from 250 years of common garden experiments, researchers conclude that we can expect the greatest adaptive response to climate change to occur when populations are large, have high genetic variability, selection is strong, and there is ecological opportunity for establishment of better adapted genotypes. (Alberto et al. 2013. , *Global Change Biology* 19: 1645–1661. doi: 10.1111/gcb.12181)

Recent declines of trembling aspen (*Populus tremuloides*) in North America linked to climate

Trembling aspen recently experienced extensive crown thinning, branch dieback, and mortality across North America. This study finds that exceptional droughts were a major cause of the decline episodes, especially in the drier regions, and that aspen is sensitive to drought in much of its range. Coupling a bioclimate model with climate projections suggests that we should expect substantial loss of suitable habitat within the current distribution, especially in the USA and Mexico. (Worrall et al, 2013, *Forest Ecology and Management* 299: 35-51)

Sensitivity of salmonid freshwater life history in western US streams to future climate conditions

Researchers projected effects of mid-21st century climate on the early life growth of Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead (*O. mykiss*) in western United States streams. Air temperature and snowpack trends projected from observed 20th century trends were used to predict future seasonal stream temperatures. Fish growth from winter to summer was projected with temperature-dependent models of egg development and juvenile growth. Based on temperature data from 115 sites, by mid-21st century, the effects of climate change are projected to be mixed. Fish in warm-region streams that are currently cooled by snow melt will grow less, and fish in suboptimally cool streams will grow more. Relative to 20th century conditions, by mid-21st century juvenile salmonids' weights are expected to be lower in the Columbia Basin and California Central Valley, but unchanged or greater in coastal and mountain streams. Because fish weight affects fish survival, the predicted changes in weight could impact population fitness depending on other factors such as density effects, food quality and quantity changes, habitat alterations, etc. The level of year-to-year variability in stream temperatures is high and the analysis suggests that identifying effects of climate change over the natural variability will be difficult except in a few streams.

(Beer and Anderson, 2013, *Global Change Biology* 19: 2547–2556. doi: 10.1111/gcb.12242)

Coral reefs may be able to adapt to moderate climate change

Coral reefs may be able to adapt to moderate climate warming, improving their chance of surviving through the end of this century, if there are large reductions in carbon dioxide emissions, according to a new study. Results further suggest corals have already adapted to part of the warming that has occurred. ... > *full story*

Dan Isaak's Climate-Aquatics Blog #50 (attached) - Mechanisms of change in fish populations: Evolutionary responses

"Another mechanism that adds an interesting twist to the climate response of fish populations is evolution. As we saw in earlier blogs (#'s [31](#) and [32](#)), fish and other critters can, and are, adjusting to climate change by shifting their phenologies in terms of migration dates, breeding seasons, maturation, etc. At the boundaries of distributional ranges they're also exposed to warmer thermal regimes and shifting into new ([blog #35](#)), and out of old ([blog #34](#)), geographic locations. Those shifts keep the bulk of a species within a climate niche similar to the historical one, but near the margins of that niche selective pressures should come into play to allow individuals and populations with certain genetic traits to do better or worse over time. An important question is whether evolution could happen fast enough that it helps species adapt to climate change and provide additional resilience".

Understanding relationships among abundance, extirpation, and climate at ecoregional scales

Recent research on mountain-dwelling species has illustrated changes in species' distributional patterns in response to climate change. Abundance of a species will likely provide an earlier warning indicator of change than will occupancy, yet relationships between abundance and climatic factors have received less attention. Researchers tested whether predictors of counts of American pikas (*Ochotona princeps*) during surveys from the Great Basin region in 1994–1999 and 2003–2008 differed between the two periods. Additionally, they tested whether various modeled aspects of ecohydrology better predicted relative density than did average annual precipitation, and whether risk of site-wide extirpation predicted subsequent population counts of pikas. Several patterns of change in pika abundance at range edges were observed that likely constitute early warnings of distributional shifts. Predictors of pika abundance differed strongly between the survey periods, as did pika extirpation patterns previously reported from this region. Additionally, maximum snowpack and growing-season precipitation resulted in better-supported models than those using average annual precipitation, and constituted two of the top three predictors of pika density in the 2000s surveys (affecting pikas perhaps via vegetation). Unexpectedly, extirpation risk was found to positively predict subsequent population size. These results emphasize the need to clarify mechanisms underlying biotic responses to recent climate change at organism-relevant scales, to inform management and conservation strategies for species of concern. (Beever et al., 2013, *Ecology* 94:1563–1571. <http://dx.doi.org/10.1890/12-2174.1>)

Climate already affecting agriculture (article attached)

"Two beloved crops—coffee beans and wine grapes—are on the leading edge of agricultural products that will soon be affected by climate change. Using climate models that predict changes in temperature and precipitation for the areas in which grapes and coffee grow, botanists and conservationists are addressing what is likely to happen to production and how different mitigation strategies may affect local economies and ecosystems. Forward-thinking growers are already experimenting with adaptations." Amy Mayer, *BioScience*, October 2013 / Vol. 63 No. 10

Toxic Algal Blooms And Warming Waters: The Climate Connection

As we move into a warmer climate there will be a longer growth season for harmful algal blooms to flourish, both in the marine environment and fresh waterbodies. Dinophysis is an algae found around the world and documented in Northwest waters for decades - scientists think it's becoming more toxic as ocean conditions change, in part due to climate change.

POLICY AND MANAGEMENT - MITIGATION AND ADAPTATION

We need climate-change risk assessment

By Michael Bloomberg, Hank Paulson and Tom Steyer, Thursday, October 3, 5:42 PM Washington Post Opinion

Michael Bloomberg, an independent, is mayor of New York. Hank Paulson, a former chairman of Goldman Sachs and Treasury secretary in the George W. Bush administration, is chairman of the Paulson Institute, which promotes sustainable economic growth. Tom Steyer is the founder of Farallon Capital Management and co-founder of Next Generation.

“If the United States were run like a business, its board of directors would fire its financial advisers for failing to disclose the significant and material risks associated with unmitigated climate change.

Managing risk is necessary for individuals, investors, businesses and governments. As individuals, we buy insurance for our homes, vehicles and health because the future is unpredictable. Businesses take similar actions and save, when they can, for the next economic downturn. Investors diversify their portfolios and hedge their bets for the same reason. And for governments, managing risk can mean anything from maintaining a standing army (in case of war) to filling a strategic petroleum reserve (to protect against severe shocks in oil prices). As businessmen and public servants, we are intimately familiar with the systems used to manage risk. They are central to informed decision-making. **But today, the world faces one of the greatest humanitarian and economic challenges of our time: the threat of global climate change. And in this arena, our risk-assessment systems have broken down.** This ignorance cannot be allowed to continue”.

Former Wall Street Journal Meteorologist Explains Why He Decided Never To Fly Again

For a meteorologist like Eric Holthaus, the fifth Intergovernmental Panel on Climate Change is something like waiting for the Super Bowl for six years. Holthaus, who writes for Quartz and formerly for the Wall Street Journal, was awake at 4 a.m. on a Friday morning reading through the summary that made it clear the world is running out of time to act. Boarding a plane home to Wisconsin, he broke down in tears. He determined to stop flying, a decision that has gained national attention. “It’s not worth the climate,” one of his tweets said. For people who don’t drive much but fly often, planes can account for three-quarters of a person’s emissions.

New Sea Level Rise Executive Order in Delaware

Governor Jack Markell of Delaware, a Democrat, has signed an executive order requiring all state agencies to take sea-level rise into account when designing and locating state projects. The order also requires agencies to develop strategies to make state facilities and operations better prepared to deal with climate change and sea-level rise.

NOVEMBER CLIMATE QUIZ ANSWERS

1. According to global surface temperature data from the National Oceanic and Atmospheric Administration and NASA's Goddard Institute for Space Studies, how many of the top 10 hottest years on record have occurred in the past 10 years?

ANSWER: NINE

2. How many pounds of carbon dioxide is released by burning one gallon of gasoline?

- a. About 1 lb.
- b. About 5 lbs.
- c. About 10 lbs.
- d. About 20 lbs.

CORRECT ANSWER – d, about 20 lbs.

3. About how many tons of carbon dioxide does the average American emit annually?

ANSWER: c, 20.

According to the United Nations Statistics Division, in 2007 the average American emitted 19.74 tons of carbon dioxide. Qatar tops the list of per capita emitters, with the average Qatari spewing more than 55 tons of CO₂ into the atmosphere.